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LESSONS WITH NATURE

Albert Leonidas Mebane

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With Compliments of

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A. & T. College, Greensboro, N. C.

FOR SCHOOL, GARDEN
FARM AND HOME

By ALBERT LEONIDAS MEBANE

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BY

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A Good Crop

TO MY PARENTS

Born in slavery, but thoughtful in freedom, this little work is affectionately inscribed as a slight tribute to their great desire and wise and sympathetic advice that served to instill in me a love for all that pertains to farm life.

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The writer wishes to express here his indebtedness to Dr. S. B. Jones, Director of Academic Department, A. & T. College, Greensboro, N. C., for critical reading of the manuscript and for the many helpful suggestins offered by him.

Grateful acknowledgement is also due my wife, Mrs. Blanche C. Mebane, for valuable assistance in working out the material for the experiments.

PREFACE

The purpose of this pamphlet is to stimulate the study of agriculture in our public schools and our homes so as to give the teacher as well as the pupil a clearer idea of how to present and study various topics on agriculture.

I trust that this booklet will help to pave the way for other Negro writers on agricultural subjects.

In many of our public schools the subject of agriculture is not receiving the attention that it deserves. In my opinion, agriculture should be taught in all of our schools outside of the larger cities. Everything is beginning to point that way now, and it is believed by many that the near future will find agriculture in every public school on par value with the other subjects of the course. Agriculture is a fundamental subject and should be taught as such. It is surprising to know how many children really believe that potatoes grow on trees, how many teachers think pineapples do, and hold as absurd and erroneous ideas of many common things.

Agriculture, when properly taught, not only opens up the common things to the pupil, but will develop the mind and make the child broader in ideas. In places where the school gardens are carried on, the child is developed physically as well as mentally. It is the study of Nature that creates in the individual a love for it, and will help him to fully appreciate that "God is present everywhere." The helpful influences which we gather from the study of agriculture in our public schools will go farther than the school room. It will enter the home, stimulating the pupils to beautify their lawns by planting flowers and grass; the back yards will be made into vegetable and flower gardens, and all unproductive places will be made productive. Furthermore, the teaching of planting gardens, building lawns, planting trees and taking care of the same will develop in the child industry and thrift.

In a state like North Carolina where about eighty per cent. of her people live in the rural districts, the successful teacher will constantly make references to the facts and principles of agriculture, even while teaching the other branches of study. The city pupils should become more acquainted with rural life,

and the country pupils should know more of the life surrounding them, and be encouraged to remain upon the farm and develop its resources. In view of these facts, it seems to be of great importance for the pupils to be taught more about the things which they see, handle, wear and eat every day.

In this pamphlet no effort has been made to present anything new, nor is any topic treated exhaustively. The object sought in these lessons is simply to suggest some practical things that will be of some real value to those who love Nature. These lessons and experiments are the outcome of the nature talks that the writer gave to the seventh grade pupils while Principal of the Williston Graded School, Wilmington, N. C.

At the end of this volume a few simple additional experiments have been added, which may prove very helpful to the young minds.

A. L. MEBANE.

Agricultural and Technical College, Greensboro, N. C.
Nov. 1, 1917.

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HOW THE SOIL WAS FORMED

Lesson Plan 1.

I. Purpose of the Lesson.—To acquaint the pupils with something of the origin of the earth.

II. Analysis of the Subject Matter.—

(a) Origin of the soil.
(b) Several agents that help to make the soil.
(c) Three sources of soils.

III. Method of Presentations.—Take the pupils down to some creek or river. Examine the soils found there. Tabulate the result. By the color of the soil, let the pupils determine whether it is fertile or not. Why is the soil more fertile near the stream than on the hill side near by? Dry the samples of the soils collected. Note the change in color. Explain what makes the change.

Lesson 1.

We are told by some of the wise scientists that in the dim past the earth was a part of the sun, which was thrown off into space in a molten condition and held there by a great force which is called gravity. After many, many years this molten mass, called the earth, cooled and became rock bound. This condition existed a long, long time before any great changes occurred. In this early age of the earth's existence there were many agents at work liberating the plant food which was locked up in the rocky mass. Doubtless the water was the greatest agent in bringing about the results by which plant food could be made available. This was effected by the force of falling rains, hail and snow. All of these would enter the crevices of the rocks and force them open upon freezing.

The sun has played an important part in forming soil. We all know when a blacksmith puts a tire on a wheel, he always heats it. When in this condition, he fits it to the wooden rim and then cools it suddenly in a bucket of water. What happens to the tire? We notice that it fits closely. This teaches

us that heat expands substances and cold shortens or contracts them. One often puts the top of a fruit jar in hot water before opening it. The railroad irons fit closely in summer while in winter they are wide apart. What makes these changes? Now the sun acts upon the rocks the same way. In the summer, the hot sun expands the rocks and at night they cool. This will tend to make crevices and many times break off pieces. Notice the rocks in your neighborhood, do you see any crevices in them? Can you remove any small pieces off of them? This is the result of heat and cold.

During the early days of earth formation there was a class of plants that was capable of decomposing the rocks by feeding on some of the insoluble compounds and making them soluble. These plants which grew were very simple in structure, yet they were able to live upon the mineral constituents alone and derive their nitrogen from the air. These very tiny plants were active in the early formation period. After this bacterial age, as it might be called, larger plants were able to grow, such as lichens and mosses. These were also able to grow upon solid rocks and obtain a great deal of their food from the air, and in their death and decaying bacteria acted upon them, forming humus which is so essential to plant growth. Larger plants grew on the sandy-loam which had been formed, their roots penetrating the rock crevices and farther splitting them. The roots also died, rotted and finally becoming humus. They left openings in the rocks so water could freely penetrate. The soils and rocks are still being acted upon by oxidation, gravitation, winds, rain water, tides, earthquakes, animals, worms and countless other things, all of them tending further to pulverize the soil particles and making them finer in texture.

The soils which we have in our own vicinity come from one of the three sources; namely, the alluvial soil, or soil which has been brought from a distance by a stream, as the black land on the river bank; sedimentary, or a soil which has been formed out of the rock just beneath it; and the glacial soil, that soil which has been brought down from the North by the glaciers, in the glacial period. The glacial soils will not be found in the South as glaciers did not extend farther south than Pennsyl-

Studying Soils

vania. Therefore, all of the Southern soils are from the two first sources mentioned above.

As some one has said, the soil is the home of the plant. It is the upper layer of the surface of the earth. We can always recognize it by the color, the organic matter found in the soil giving it the dark color. Just beneath the soil is the sub-surface soil which may contain some vegetable matter. The roots may get some food from t. This soil is generally at the bottom of the furrow made by the farmer's plow. The sub-soil can be clearly distinguished from the two other soils mentioned above. As a rule it is red in color, very compact, not productive and composed almost entirely of clay.

Now that we have learned something about the soil, its origin, and how it was made, let us examine the depth. Dig a hole a few feet deep. Are there any differences in the color of the top and bottom soils? Which contains more clay? Which is the darker? The dark soil contains the vegetable matter. Notice how deep the farmer plows his land. From the above questions can you determine the part of the soil from which the plant draws its food? All fertile soils contain organic matter and mineral matter.

To make certain that the above lesson is thoroughly understood by the class, the teacher should ask the following questions:

1. What two kinds of material do we find in the soils?
2. Do soils vary in amount of organic matter they contain?
3. When you add manure to the soil what effect does it have on the color and texture of the soil?
4. What is a soil, a sub-surface soil, a sub-soil?
5. What is a productive soil? Is the sub-soil productive? Why not?
6. Give briefly the origin of the soil and how it was made.

Experiment No. 1.

Object—To secure samples of soils for further work.

Material—Soil collecting boxes, small digger and a shovel.

Procedure—Collect and classify the soils of the community. Have each pupil in the class to bring samples of the soils found on his farm or garden. Quart samples will be large enough. Empty each sample out of the collecting boxes on separate sheets of paper and compare the samples. Put all samples together that are very much alike, so as to reduce the number. Before putting samples away, thoroughly dry and pulverize them. In most localities it will be an easy matter to secure samples of sand, clay, clay-loam, loam, gravelly and organic soils.

CLASSIFICATION OF SOILS

Lesson Plan 2.

I. Purpose of the Lesson.—To familiarize the pupils with various kind of soils.

II. Analysis of the Subject Matter.—
   (a) Define each kind of soil.
   (b) Discuss the advantages of a sandy-loam and the disadvantages of a clay.
   (c) Experiment.

III. Method of Presentation.—The method of teaching the above outline, is to examine the different kinds of soils that have been collected and classify them. Each member in the class should perform the experiments. Before leaving this lesson, be sure the pupils are well acquainted with all kinds of soils in the vicinity of the schoolhouse.

Lesson 2.

1. Loamy Soils.—These soils are composed of about equal amounts of sand and clay with a great deal of organic matter in them.

2. Sandy Loam.—From the name one can see that this soil contains more sand than clay, also in such soils will be found a great deal of organic matter.

3. Sandy Soil—Composed largely of sand, such a soil is poor farming land.

4. Clay Loam.—Contains more clay than sand with more or less organic matter.

5. Clay Soil.—Composed largely of clay, very sticky when wet, difficult to work, a very cold soil, because of its great capacity to hold water.

6. Gravelly Soil.—This soil is made up of pebbles as large as bird eggs. Such soils are generally poor in vegetable matter.

7. Organic Soil.—The black soil of swamps, decayed wood and leaves with earth, etc.

Experiment No. 2.

Object—To note the effect of stirring soils when too wet.

Material—Sand, loam, clay, clay-loam, gravelly and organic soils. Several small pans and some water.

Procedure.—Place in separate pans one pint each of the above named soils. Wet each soil thoroughly; stir two minutes; set the pans containing the wet soils in the sun to dry. What is the result upon drying?

Experiment No. 3.

Object—To teach the pupils what happens to soils when they are worked or stirred at the proper time after a rain.

Material—Same as used in experiment Number 2.

Procedure.—Now take a similar lot of soils as in last experiment; put in pans; wet thoroughly; do not stir; set these in the sunshine to dry. What happened to the soils in the last experiment? When comparatively dry stir these lots of soils. Compare this lot of soils with those in the last experiment. Should the soil be stirred while wet? Why not? Should the soil be stirred when it is dry enough after a rain? Give a good reason why it should be.

HUMUS

Lesson Plan 3.

I. Purpose of the Lesson.—To study the service of humus to soil, and in turn to the farmer.

II. Analysis of the Subject Matter.—

(a) How humus is formed.

(b) Value of humus.

(c) Why the soil has its dark color.

(d) How to maintain humus in the soil.

III. Method of Presentation.—Ask the pupils to bring to the schoolroom some fertile soil out of the woods. The teacher will show the class that humus is the product formed by the decaying of organic matter. Plowing manure under, in time, forms humus.

Lesson 3.

Humus is the product formed by the decaying of organic matter. The dark material, which we find in the woods near a rotten tree and stumps, decayed leaves and the like, is humus. In fact, as a rule, the humus in the soil is that which gives it that dark rich color that we find when vegetable matter is abundant. Partly decayed vegetable matter is not humus. Humus is formed by the action of small plants which are called bacteria, on organic substances in the presence of moisture, air and a certain amount of heat.

Soils where no cropping has been carried on, as a rule, are rich in humus, especially if trees and grasses have been growing on them.

Some of the principal uses of humus are: First, it furnishes abundant food for the growing plant. All dead organic matter is composed of nitrogen, which is so very essential to plant growth. Hydrogen, oxygen and carbon will also be found in all dead organic matter. Second, humus improves the texture of the soil; sandy soils will be made more compact, thereby increasing their capacity to hold water; while on the other hand, it unites with clay, makes it less retentive, and therefore more porous. Humus being of a loose, fine texture, increases the capacity for capillary water in sandy soils, while in clay soils it acts just the opposite.

Plant food must be in a soluble condition, that is watery, before the root-hairs can use it. In order to get the food in this liquid state there must be a sufficient supply of capillary

moisture in the soil. If this moisture is lacking in the soil it may be increased by adding organic matter to it or by making the soil particles finer in texture.

The root structure is very intricate; that is, it is very difficult for beginners to understand it. For example, take a turnip or any of the garden plants which have tap roots. Notice that leaving this large root in all directions are smaller roots,, and there are still smaller ones attached to these rootlets, which cannot be seen with the naked eye. These are called hair roots bcause they are so small, and yet, all of the food which comes from the earth must pass through them before getting into the body of the plant. Most of these little rootlets are unicellular (one-celled organisms) filled with an albuminous substance known to the scientists as protoplasm, which forms the physical basis of all life.

The questions now arising in our minds is how liquid food enters these little hair roots. This is done by a process called osmosis. It has been observed that, if a dense liquid is separated from a less dense one by a thin membrane they will gradually mix, only the weaker liquid will flow much the faster.

Experiment No. 4.

Object—To show the class some hair roots.

Material.—Some small grains: Wheat, oats, rye or some garden seed. Two plates, two pieces of blotting paper and some water.

Procedure.—Germinate some of the seed you have between two pieces of wet blotting paper. Put the blotting paper containing the seed between two plates, so as to preserve the moisture. Put the plates in a warm place. Examine the roots in a few days. Note the fine white material. These are hair roots, one-celled tubes which take in most of the plant food from the soil passes through the roots to all parts of the plants. Thousands of these root hairs are found on a single root.

Experiment No. 5.

Object.—To show how the water passes through the root hairs.

Material.—Wide mouth bottle, an egg, glass tube and water.

Procedure.—Take an egg, remove a part of the shell from the larger end of the egg without breaking the skin just beneath the shell, also remove the shell off of the small end of the egg (one-half of an inch in diameter). Insert the glass tube a short distance in the small end of the egg, seal around the tube with sealing wax. Fill the bottle with water, and place the large end of the egg on the bottle in the water. In the course of a few hours it will be seen that the white of the egg and water will be flowing up the tube. This water is making its way through the membrane by osmotic process. In the same way water laden with plant food enters the plants through their tiny roots hairs.

After the liquid enters the root cells, there must be some force to carry it to the top of the plant. In an animal we can very well understand how the blood is forced to all parts of the body; there is an engine which does it. No such exists in the plants, therefore there must be some other force. The water is carried to all parts of the plants by means of capillary attraction, which is a power that tends to raise the level of the liquid in a small tube if it is inserted in a vessel of water.

Experiment No. 6.

Object.—To show that plant roots can absorb some food from solid rocks.

Material.—A polish piece of marble, some wet saw dust and some seed.

Procedure.—Take a polished piece of marble; put some wet saw dust on it and plant some seed in the saw dust. After the seed germinates, let the plants stand for about ten days. Is the marble rough when the saw dust is removed? What does this prove? Does not this show that the root hairs of a root system can gather some food from undissolved material? This is done by certain acids being secreted in the membrane.

PLANT FOOD IN THE SOIL

Lesson Plan 4.

.I Purpose of the Lesson.—To teach the pupils that soils

must contain certain elements in an avaliable condition for plant growth.

II. Analysis of the Subject Matter.—

(a) Plants depend upon the soil for food.

(b) Name of the necessary elements for plant production.

(c) Elements that are deficient in many soils.

III. Method of Presentation.—This lesson, while it brings some technical names to the class, may be conducted in such a way that the names of the elements will be remembered and will be of practical use in later years. The teacher should call the pupils' attention to the fact that plants get their food from two sources; namesly, the soil and the air.

Lesson 4.

We have already learned that the plants must depend upon the soil for food, therefore, it is necessary that the soil should be supplied with it in an available condition so the roots of the plants can readily take it up and use it. Then we ask ourselves the question, What is plant food? To answer such a question, let us go to the plant and ask it of what is it composed? Let us for convenience take a corn plant which has already been analyzed. It has been found out that a corn plant contains the following elements: namely, carbon, nitrogen, oxygen, hydrogen, silica, lime, potash, magnesia, phosphorus, sodium, chlorine, sulphur, iron and a trace of aluminum. These make up the food for the plant and they are essential for plant development. The above-named constituents will be found in all growing plants in different proportions.

Fletcher in his book on soils, states that "No one kind of rock contains all of the elements, but all of the rocks from which fertile soil is made contain at least seven of them: Nitrogen, potassium, phosphorous, calcium, iron, magnesia and sulphur. No plant can grow successfully unless these seven are present in the soil. They constitute from 80 to 90 per cent. of the most fertile soils."

King says in his book on soils: "That plants cannot thrive in a soil destitute of nitrogen, potash, lime, magnesia and phos-

phorous acid. A soil entirely lacking in any one of these is, for that reason, an infertile one."

While there are about ten essential elements for plant growth, there are only three or four elements of which the farmer or gardenere can exhaust his soil, and these are nitrogen, phosphorus, potash and sometimes lime.

Nature seemingly has provided an inexhaustible supply of all the elements of plant food with the exception of the above mentioned. When any of these elements are deficient in the soil, man must supply it with them, by manuring with green, stable, or commercial manures.

Experiment No. 7.

Object.—To show the effect of plant elements in the soil on the growth of crops.

Material.—Eight tomato cans, sand, lime, phosphoric acid, nitrate of soda, potash and some stable manure.

Procedure.—Fill eight tomato cans with clear sand. In the first two pots mix thoroughly about three tablespoonfuls of lime plus one teaspoonful of phosphoric acid. In the third mix three teaspoonfuls of lime and one spoonful of sodium nitrate. In the fourth can use only the pure sand, but water the plants as soon as they germinate with water that has been percolated through stable manure. In the fifth mix some very fine manure with the sand. In the sixth mix one tablespoonful of lime, one teaspoonful of phosphoric acid, half teaspoonful of nitrate of soda and two teaspoonfuls of potash. In the seventh double the amount of the sixth. In the eighth can put in the pure sand as collected. Plant four grains of corn in each can. Be sure to give the same care to all the cans. Tabulate the results. What have you observed in this experiment?

AIR: A SOURCE OF PLANT FOOD

Lesson Plan 5.

I. Purpose of the lesson.—To show that plants get food from the air.

II. Analysis of the Subject Matter.

(a) Importance of air to the plant.

(b) The food that plants get from the air.

(c) The green matter in the leaves of the plants.

III. Method of Presentation.—Have the pupils read over the lesson, then perform the experiments. These experiments should give the pupils an insight into the use of air to the plants.

Lesson 5.

We have seen already that a great deal of plant food comes from the soil, yet the air plays a very important part in furnishing some of the food for the plants. Plants get nitrogen, carbon and some oxygen from the air, and the other elements from the soil and water. Take a growing stalk of corn about to tassel; it contains eighty per cent. of water and twenty per cent. of dry matter. Of this twenty per cent., the food which is obtained from the soil forms one per cent., except nitrogen, that comes from the soil and air, which is two per cent. The seventeen per cent. unaccounted for is obtained from the air in the form of a gas called carbon dioxide. All the green plants have the power to decompose this gas, use the carbon and allow the oxygen to go free. Some one has called this process the fixation of carbon, or the assimilation of carbon. Most of the assimilation of carbon takes place in the green leaves of the plants, yet other green parts of the plants may assimilate some.

The great power of plants to retain the carbon depends upon the coloring matter of the leaves known as chlorophyll. The chlorophyll grains impart the color to the leaves, but it seems that the main function of this material is to wrest the energy from the sun and use it in making the carbon dioxide which enters the mouths or stomata of the leaves and the water coming up through the plant from the soil the leaf cells form starch sugar and other substances of which plants are made. Some plants do not have this power to get carbon dioxide directly from the air; such plants as the mushrooms and the fungi

must get their carbon through the decaying of other organic matter; for example, decayed stumps, roots and leaves, etc.

Experiment No. 8.

Object.—To show that plants must depend upon the air as well as the soil for food.

Material.—Two tumblers, some clay-loam, beans or peas and some water.

Procedure.—Place an equal amount of soil in each of the two tumblers. Fill the tumblers to one-half inch of the top. In one, plant seeds of beans or peas just as you would in the garden, in the other tumbler plant the same kind of seed. Keep the soil in one tumbler saturated with water, in the other just moist. Watch the result. Do the seed in both tumblers germinate? The tumbler which contains an excess of moisture prevents the access of air that is necessary to the germination of seed. The other tumbler which is kept just moist will allow sufficient amount of air to come in contact with the seed to insure germination.

Experiment No. 9.

Take two flower plants; keep an excess of water around one, and have the soil around the other moderately moist. Tabulate the result. What makes the difference in color and growth? Do you see the benefit of drainage?

Experiment No. 10.

Object.—To show the per cent. of air in different soils.

Material.—Four tomato cans, scales, several kinds of soils and water.

Procedure.—Fil a tomato can with clay and weigh. Gradually add water until it appears at the surface. How much water have you added? Weigh the can containing the soil. Compare the first and second weights. Do the same with several kinds of soil. From the results obtain which soil has the greatest air space?

THE SUPPLY OF WATER IN THE SOIL

Lesson Plan 6

I. Purpose of the Lesson.—To show that the soil contains water.

II. Analysis of the Subject Matter.
   (a) Presence of water in the soil.
   (b) Kinds of water.
   (c) Use of capillary water in the soil.
   (d) Water holding capacity of the soil.
   (e) Percolation.

III. Method of Presentation.—The method of teaching this lesson to the class is to have each pupil read the two paragraphs. Explain what he has read. After this has been done, the above facts can be explained through experiments. Each member in the class should perform the experiments, and class demonstrations should be conducted by the teacher.

Lesson 6.

Natural soils contain three classes of water; free, capillary and hygroscopic water. The water which makes wells and any stream is known as free water. Such water will not be found near the surface of well drained plots of land except after a heavy rain. There is a natural level for free water in every soil. This is determined by the depth one would have to dig in order to find a good well of water.

The capillary water is that film of moisture that surrounds every individual particle of soil, and it is upon this water that all growing plants must depend. The finer the soil particles, the greater the power of that soil to hold water. The experiments below will demonstrate the water holding capacity of the soils and the rate of the movement of the water in the soils.

Hygroscopic water is the film of moisture around each particle of soil independently of the capillary water. It is held more firmly to the particles of soil than the capillary water. Road dust may still contain from one to ten per cent. of hygro-

scopic water. This moisture can only be driven off by heating to a temperature of boiling water. The clay soils usually contain a great deal of hygroscopic moisture.

Experiment No. 11.

Object.—To show the water holding capacity of soils.

Material.—Five lamp chimneys, scales, a rack and some cheese cloth.

Procedure.—Tie a thin cloth cap over the small ends of the chimney. Weigh each chimney separately. Record the result. Now fill each chimney up to the bulge, or to a uniform height with soils of different characters. In this experiment be sure to use the following soils, a sandy soil, a mixture of sand and clay, a clay, a sandy loam, and a soil made up of leaf mold. When each chimney has been filled with the different soils, weigh them as before. Make a record of each weighing. Place the chimneys in a rack and pour water in the upper end until the soil is thoroughly saturated. Cover the tops of the chimneys and allow the surplus to drain off. Weigh the chimneys containing the soil after five hours, and by substraction find the amount of water retained by each soil. From this experiment find out how much water would 1000 pounds of each soil hold. Keep up the weighing of these soils for several days; tabulate your results. Which soil holds the most water the longest? Explain why. Can you explain why crops will "burn" quickly during dry weather when planted on sandy ground?

Experiment No. 12

Object.—To show how water rises in the soils by capillarity.

Material.—Lamp wick, five lamp chimneys, several kinds of soils, vessel to hold water, some cheese cloth and some water.

Procedure.—Place the end of a lamp wick in some water. Note what happens. Touch a piece of blotting paper in ink or water. What happens to it? Take five lamp chimneys, tie a piece of cheese cloth over the small ends and fill each chimney with different kinds of soils. Place each chimney, cloth end downward, in a pan containing an inch of water. Note the

time and distance the water will rise in each chimney through the soils. Tabulate result at end of one hour, one day, two days, and even a week.

This rise of water is the most important function of soil in relation to farm crops. This is the way the water laden with plant food comes in contact wtih the roots. This rise of water through the soil is called capillarity. If the chimneys with the soil are weighed before and at intervals up to the time the soils have absorbed all the water they can take up, the difference in weights is the amount of water absorbed and will give an index to the water holding capacity of each soil. After performing the experiments, which soil would you prefer in times of drought? Give reasons for your answer.

Experiment No. 13.

Object.—To show that water percolates or goes downward in the soil.

Material.—Same as in last experiment.

Procedure.—Tie pieces of cloth over the ends of six lamp chimneys and fill each with a different kind of soil. Pour water into all the chimneys and note how long it takes for the water to pass through each soil. Note the amount of water that remains in the soil with that which passes through in each one.

SOIL MANAGEMENT

Lesson Plan 7.

I. Purpose of the Lesson. To teach the pupils the proper management of the soil.

II. Analysis of the Subject Matter.

- (a) The object of tillage.
- (b) The benefits of tillage.
- (c) Deep and shallow tillage.
- (d) Tools used.

III. Method of Presentation. In order to get the pupils interested in this lesson, let the teacher tell how the Indians tilled their crops with the crooked stick. Let them know that all the Indians did was to scratch the soil and plant

the seed. Study the evolution of the plow. Read the story of Jethro Tull, an Englishman, who said that "Tillage is manure."

The teacher along with the pupils should visit some good farms and learn the names of all the tools used in tillage. Discuss with the pupils the tools that are used for shallow as well as those for deep tillage.

Lesson 7.

The primary object of tilling the soil is to make a seed bed in order that the seed may germinate and develop quickly into a plant. Nature scatters the seeds broadcast and they grow when they fall in favorable soil, but man must prepare a seed bed for them if he expects to reap an abundant harvest.

The second object of tillage is to make the soil particles smaller. Soils that have not been cultivated for some time become hard and packed, and therefore unproductive. Soils of like nature must first be plowed with a turning plow and then further be made finer by using harrows and a roller. The soil cannot be made too fine for the seeds and young plants, all things being equal, the finer the soil the better and quicker the growth.

The first benefit we get from tillage is: In the operation weeds are destroyed, for weeds are, as a rule, expensive boarders; they pay poor rent, are hardy drinkers and, therefore, rob the soil of its moisture and food. However, weeds, as bad as they are, sometimes prove a blessing rather than a curse, because they make the lazy farmer or gardener work his soil often in order to kill them, and by so doing he will unconsciously work his crops.

The second benefit of tillage is that the moisture that is so essential for the plant is saved. The soil particles are made smaller, thus making the moisture holding capacity greater. There is a field at the Agricultural and Technical College, Greensboro, N. C., where the soil from ten to eighteen inches deep will be found to contain about 17 per cent. of water in the summer time, while another part of it at the same time will not have more than 11 per cent. or 12 per cent. of water. What

makes the difference? The answer is, the first part of the field has been tilled properly, while the other part has not, one part has been sub-soiled, the other part has not.

Tillage prevents evaporation by breaking up the capillary tubes which allow the water to escape; or in other words, tillage forms a blanket of loose soil and this prevents the sun from causing the evaporation of the underlying moisture from the soil. Tillage prevents much erosion or washing. The water will sink into the soil rather than run off and carry the plant food. It loosens the soil; it dries the soil; it exposes the soil to atmospheric action; it increases the amount of available plant food; and it covers the seed.

When we plow the land with the turning plow, this operation would be known as deep tillage. Can you name other ways of deep tillage? Can you name some advantages of deep tillage? Does it bring the undersoil to the surface and permits greater depth for the roots? Is it an advantage for the farmer to lay by his corn with deep tillage implements? The deep tillage implements will cut off the roots of growing plants. In view of this fact when should such implements be used? Cultivators, harrows, rakes, and hoes are made to form dust mulches and therefore will not disturb the roots of plants. These tools will help to conserve the moisture and should be used when the plants get large. Now discuss the difference between deep and shallow tillage. Tell the advantage and disadvantage of the two kinds of tillage.

WHY SOIL BECOME UNPRODUCTIVE

Lesson Plan 8.

I. Purpose of the Lesson. To show the pupils why so much land in the South is unproductive; second, to teach them how to reclaim the soil fertility.

II. Analysis of the Subject Matter.
   (a) Why soils are unproductive.
   (b) Prevention of the washing of soils.
   (c) Some methods of keeping the soil fertile.

III. Method of Presenetation. Make field excursions. Call the pupils attention to various fields which have been cultivated properly and compare them with improperly cultivated ones. Are there any difference in the crops? Compare the houses and stock. What makes the difference?

Lesson 8.

Many of our soils, especially those in the Southl naadre unproductive. Much of this has been brought about by the one crop system, or in other words growing the same crop on the same plot of land year after year. This is harmful to the soil even if there is put back on it the same amount of plant food that the plants have used up, because certain kinds of insects or diseases will become prevalent and will therefore prove detrimental in the couse of time. The boll weevil in the cotton states and the chinch bug and the corn worm in the corn growing states are good examples of the above statements.

The fertility of the soil is also wasted by erosion; such as, washing of the soil by heavy rains. The winds in many localities blow much of the top soil away. Some method of keeping the soil fertile: This can be done by rolling the land after it has been harrowed. To keep soils from washing and deteriorating, deep stirring, especially in the clay soils is necessary. This breaks up the hard pan, and will allow the water to soak down in the soil instead of running off. Deep stirring gives greater root basin and at the same time exposes more soil to the air and to the frost. Oxidation makes the soil more fertile by making unavailable plant food available. The action of frost on the soil further pulverizes it, and makes it more pliable. To prevent erosion. Plants must be grown which have matted roots, these tend to hold the soil together. Sow such soils down in grass, clover and small grains for several years, then other crops like corn, cotton and tobacco may be planted for a year or two, after which introduce matted roots again. In very hilly localities curved furrows and terracing will help to prevent washing away of the fertile soil. Rotation of crops will also prevent washing. Plow under green manure, add stable manure, lime much of the land and drain the soil. These will help much in keeping up the soil fertility.

ACID OR SOUR SOILS

Lesson Plan 9.

I. Purpose of the Lesson—To show the pupils how to detect acid soils.

II. Analysis of Subject Matter:
- (a) Presence of acid in the soil.
- (b) Testing several soils with blue litmus paper.
- (c) Testing acid soils with garden plants.
- (d) Correcting acid soils by liming.

III. Method of Presentation—The best method in teaching this lesson is through experiments. The test for soil acidity is best made in the field.

Lesson 9.

As a rule wherever a great deal of vegetable matter has decayed, carbonic acid is formed. An acid soil can always be detected by testing with very sensitive blue litmus paper which may be obtained from any good drug store for a few pennies.

EXPERIMENT 11.

To test the soil with blue litmus paper, puddle a cup full of it with some rain water and place a small strip of the paper in it. If the soil is sour the paper will turn red when coming in contact with the wet soil.

In your garden if beets fail to grow well, it is a good indication that lime is deficient in the soil. Fields will not grow good legume crops unless lime is present. Corn and rye may do fairly well on acid soils. Sour soils can be made sweet if an application of water slacked lime in quantities of one to four thousand pounds per acre, be spread broad cast in the later fall or early spring.

MANURES: GREEN, BARNYARD AND COMMERCIAL

Lesson Plan 10.

I. Purpose of the Lesson—To teach how the soils may be made fertile.

II. Analysis of the Subject Matter:

(a) Crops used in green manuring.
(b) Special use of leguminous crops.
(c) Value of the several natural manures.
(d) The care of barnyard manures.
(e) Compost.
(f) Value of rich feed to animals.
(g) Commercial fertilizer.

III. Method of Presentation—Read over the lesson carefully, then call the pupils' attention to each of the topics. Teach the class to be observant. Tell the class that large crops can be grown without the use of commercial fertilizers. This is brought about by using large quantities of good stable or barnyard manure. Manure is rich in plant food, especially in nitrogen and potash.

The pupils should be taught that stock farming is more beneficial than grain-farming. Why is this so? It is estimated that that if animals are kept in covered stalls, fed good feed, and a liberal supply of bedding and manure saved, horses and mules will return twenty-seven dollars each to the soil yearly; cattle, twenty dollars; hogs, eight dollars, and sheep, about two dollars.

Lesson 10.

In green manuring the farmer or gardener plants such crops as oats, rye, clover and peas and plows them under to rot. The leguminous crops are especially valued for the nitrogen that they will collect from the air and add it to the soil. Under this head will be found the clovers, alfalfa, velvet beans, vetches and the cow peas which are the most common. It is somewhat strange that these plants have the power to collect nitrogen from the air and transfer it to the soil, yet it is true. Other plants can feed upon the manufactured nitrogen after it has been deposited in the soil. Every farmer and gardener knows that he can produce a better crop of corn, wheat, cabbage or potatoes after any of the above-named crops have been grown on a given plot of land. Why is this? Dig up carefully a bunch of [illegible] after it has matured. Wash the roots. What do you

see on the roots? The answer is, little knots, looking like warts. These are little fertilizer factories which have the power to collect the nitrogen from the air. When the host plant dies or has been plowed under the nitrogen which has been gathered and manufactured by these little factories is left in the soil and other plants will feed on it. Nitrogen is worth fifteen cents (15c.) or more per pound for plant food. Would it be advantageous to the farmer or gardener to grow leguminous plants? Why? The legume factories have plenty of nitrogen to gather and manufacture. The air will not become exhausted. It is said that 37,500 tons of nitrogen rest over every acre of the farmer's land.

Barnyard Manure.

The barnyard manures are the most important of all manures, because of their available plant food.

In the Farmer's Bulletin 192, United States Department of Agriculture, is given the value of the real plant food which is contained in a ton of several natural manures:

Horse manure	$2.20
Cow manure	2.02
Sheep manure	3.30
Calf manure	3.18
Hog manure	3.29
Hen manure	7.07

The farmer is constantly selling crops off his farm, therefore selling the fertilizer which the crops have gathered up from the soil. Some estimates have been given of the amount of fertilizer which a ton of timothy hay contains. It will take about $5.25 to replace the fertilizer which a ton of timothy hay will remove from an acre of soil. It has also been estimated that every ton of wheat will remove from an acre of land about $7.92 worth of plant food. Therefore one can see how the farmer constantly is selling plant food off his soil, and thereby making it poorer and poorer every year. This can be remedied in a great measure by keeping sufficient number of useful animals on the farm to consume the roughage and thereby return the manure and waste material back to the soil as a fertilizer.

The average farmer and gardener lose a great deal of their manure by piling it up against barns or allowing it to lie out in the barnyard for a great length of time. It is almost impossible to save the manure by storing it in the ordinary way. It is far better to apply it to the soil as soon as made, then what is washed out will enter the soil.

The stable of all animals should be kept well bedded so that a great deal of manure can be made. Every time the stable is cleaned out, haul the manure to the field and spread it where it is needed, and plow it under as soon as possible. Manure may be kept fairly well by keeping it rounded up in a close pile. Put a good cover over it, and now and then cool the manure down by pouring water over it. Under such a manure pile a spoon shape cement bottom should be made to keep the liquid manure from being wasted.

Compost piles consist of manure and other materials mixed, such as leaves, pine straw, cotton seed hulls with some phosphate added. Compost is valuable like the barnyard manures. These several manures have four good offects on land: First, they make the earth loose and mellow, thus allowing the air and the roots to come in close contact with the soil. Second, the soil will hold moisture better in dry weather when these manures have rotted well in the soil. Third, they furnish abundance of plant food to the roots of the growing plants. Fourth, they add many beneficial germs to the soil and cause those already there to thrive better. The richest feeds make the richest manure. Cowpea, hay, clover, cotton seed meal and other feeds that are rich in nitrogen make the best manure, therefore it is advantageous to the farmer to feed these nitrogenous crops to the animals and save the manure for fertilizing. It has been estimated that in the case of feeding cotton seed meal to the animal, not more than one-fifth of the fertilizing material is used for the body consumption, the remainder of it will be found in the manure. So one can see from this that it is far better to feed the animals rich feed and use the manure for fertilizing than to use any of them as a direct fertilizer.

The Commercial Fertilizers.

Most of the southern farmers and gardeners use too much of

the commercial fertilizers without stopping to think of the value of the constituents contained in them. These manures of course are soil enrichers and if handled judiciously in most cases are helpful. Before it is safe to use a commercial fertilizer the farmer or gardener should have a good supply of humus, as all the manures must be reduced to a liquid state before the plants can use them. When a soil contains a good supply of humus, as a rule there will be a good supply of capillary water, or it is capable of holding a sufficient amount. If there is a lack of moisture when these fertilizers are used, the crops will surely burn and prove worthless.

Most of the fertilizers are sold in bags with a guaranteed analysis. These analyses are in many cases misleading and confusing to the purchasers. The only constituents in mixed fertilizer the buyer should look for are these: viz., nitrogen or ammonia, available phosphoric acid and potash. The laws of the different states guarantee the amounts of the constituents or plant elements in each bag of fertilizer, yet the laws do not prevent the use of other statements or names on the same bag. As for example:

Guaranteed Analysis:	Per cent.
Nitrogen	8 to 1
Equivalent to ammonia	1 to 2
Available phosphoric acid	8 to 12
Equivalent or available bone phosphate	18 to 20
Total phosphoric acid	9 to 12
Equivalent bone phosphate	9 to 20-30
Potash actual	2.5 to 3.5
Equivalent to potash	3 to 5

The above fertilizer was sold in a state where ammonia is guaranteed instead of nitrogen. The dealers of the fertilizer are held responsible only for the lowest per cent stated in the guaranteed analysis on the outside of the bags. In the above analysis the actual per cent of each constituent is: ammonia, one per cent.; available phosphoric acid, eight per cent.; potash, two per cent.

The trade value of the constituents in any fertilizer may be very nearly found by multiplying the per cent of ammonia by

2.5, add the product to the percentage of phosphoric acid plus the potash. This result will be approximately the value of the fertilizer in dollars and cents: Example—Take the fertilizer that has a guaranteed analysis: ammonia, one per cent.; phosphoric acid, eight per cent.; potash, two per cent. From the rule given multiply the per cent. of ammonia by 2.5 which equals 2.5. Add to this 2.5 eight plus two the per cent. of phosphoric and potash 12.50. Therefore this fertilizer is worth $12.50. Where nitrogen is used instead of ammonia, multiply by three instead of two and five-tenths and that will give one the approximate trade value.

In cases where one is contemplating buying fertilizer the price should not exceed five dollars more than the trade values. This is allowed for bagging, handling and transportation. By this I mean, add five dollars to the commercial value and this should determine the selling price.

Problems: What is the value of a ton of complete fertilizer which has a guaranteed analysis, two per cent. of nitrogen, ten per cent. of phosphoric acid and three per cent. of potash? By the above method examine different fertilizer bags and determine the trade value of the fertilizer.

A word of caution for the farmer, and that is this, never mix the two fertilizers lime and phosphate, because the lime produces a chemical change and the phosphate is rendered less soluble and therefore it is less valuable as a fertilizer. When wood ashes and the phosphate are mixed, the same result is obtained as above; therefore, they should not be mixed together.

ROTATION OF CROPS

Lesson Plan 11.

I. Purpose of the Lesson—To show what a rotation is, and how to plan a beneficial rotation.

II. Analysis of the Subject Matter:
   (a) What is a rotation?
   (b) How to plan a rotation.
   (c) A beneficial rotation.
   (d) Two, three, four and five year rotation.

(e) Conditions affecting a rotation.
(f) Rotation to get rid of obnoxious weeds.
(g) A rotation to reduce or control plant diseases.

III. Method of Presentation—The lesson should be read over by the pupils, and each topic taken up and discussed separately. Have the pupils bring in the kind of rotation practiced in their respective communities. Compare the rotation brought in by the pupils with the one given in the lesson.

Lesson 11.

As we have already learned, one kind of crop continually grown on one plot of land for a number of years will tend to be harmful to the soil. Crop rotation then is one of the fundamental necessities of any kind of successful farming, whether it be general, special or truck farming. The average farmer is successful in proportion to the extent to which he practices a good rotation. The one crop system in the South has proven a failure in most cases, as one can see when going through our country. Our soils that were once fertile are now depleted. What caused them to be so poor? The only answer need to be given at this time is that our land has been in the hands of men who did not know the benefits of rotation.

What Is a Rotation?

A good definition would be, as some one has said, "A system of farming by which the most can be gotten from the soil and at the same time the most left in it." In other words, it must be a system of farming where the most crops can be grown that will bring money to the farmer and at the same time increase the fertility of the soil. Merely growing one crop after another crop may not be a successful rotation. But if crops are grown in succession on the same field and are so arranged the land improvement crop will be followed by a money crop, or if the improvement crop can be turned into a money crop, then we have a beneficial rotation for the Southern farmer.

How to Plan a Rotation.

There are several items that should be considered when plan-

ning a rotation, namely, the money crop, the land improvement crop, the crop that keeps the land free of obnoxious weeds and the crop that controls plant diseases. Some of the money crops for North Carolina are cotton, corn and tobacco. Cotton in certain sections of our State and corn in other sections have been the crops that have been grown so long that the soils are depleted of their fertility, and we need to plan a rotation which will increase and maintain the soil's fertility. In planning any rotation the money crop of the community must be supplemented with the soil improvement crop best adapted to the same locality.

Below is a rotation that would be beneficial to the Southern farmer:

Two Years' Rotation: Corn Belt—First year, corn and cow peas; second year, wheat, followed by peas. Cotton Belt—First year, cotton, followed by crimson clover; second year, corn, follwed by clover.

Three Years' Rotation: Corn Belt—first year, corn and peas; second year, oats and crimson clover; third year, wheat, followed by clover. Cotton Belt—First year, cotton, followed by clover; second year, oats and vetch; third year, cotton, followed by clover.

Four Years' Rotation: Corn Belt—First year, corn and peas; second year, oats and clover; third year, corn and peas; fourth year, wheat, followed by clover. Cotton Belt—First year, cotton, followed by clover; second year, oats and clover; third year, corn and peas; fourth year, rye, followed by cotton.

Five Years' Rotation: Corn Belt—First year, corn and cowpeas; second year, wheat, followed by late corn; third year, crimson clover, corn; fourth year, rye, followed by corn; fifth year, wheat, followed by clover. Cotton Belt—First year, cotton, followed by clover; second year, corn and cowpeas; third year, oats and clover; fourth year, cotton, followed by rye; fifth year, corn, followed by clover.

In these rotations one can see that the legumes play an important part. The best soil improvers for the Southland are such crops as the cowpeas, velvet pea, the clovers and the vetches. Hairy vetch when planted with small grain will help

protect the land during time and may be cut off in time to grow a crop of corn.

Conditions Affecting Rotation.

In planning a rotation, the farmer must always keep in mind what he has on the farm and what he needs, the number of farm hands engaged in the operation of the work, the capacity of the teams, the needs of the farm in the way of feed, the crops to be planted, the implements at hand, and the money invested to run the farm. Much attention must be paid to the farm in regards to its fertility. Where the farm has poor spots as well as fertile ones, a great effort will have to be made to have all the farm produce about the same quality and quantity on every acre. In many cases it will be necessary to divide the farm up into several plots or fields to get the best results. Of course common sense must be exercised in all operations on any farm, whether large or small. Inasmuch as the purpose of a rotation is to get as much out of the land as possible, and at the same time to improve the soil rapidly, no place on the farm should be neglected. Hence any rotation will be a success in proportion to the extent the land is improved.

Rotation to Get Rid of Noxious Weeds.

Many times it is necessary to rotate to get rid of some special kind of weeds. This can be accomplished in two ways: First, plant a crop that will require a long season to mature, corn and cotton are good examples. Secondly, plant a vigorous legume crop—peas and soja beans are excellent in choking out almost any weed, if planted early in the season. A great advantage always in growing cow peas is that they can be grown very successfully after a winter crop, like wheat, oats or rye.

Rotation to Reduce or Cntrol Plant Diseases.

Fungous diseases usually attack only particular kinds of crops. Where the same crop is grown on the same plot of land year after year, the spores of the fungi lodging in the ground during the fallow season will find food ready when the season

comes for them to multiply. If disease sets in in any crop, it is well worth while to try to get rid of the pest by rotation.

Lesson Plan 12.

I. Purpose of the Lesson—To teach the children how new varieties of plants are produced. Secondly, to give the pupils an idea how to grade and judge corn.

II. Analysis of the Subject Matter:
   (a) The methods of securing new varieties.
   (b) What is the pollen?
   (c) The meaning of cross, self, and near-fertiliziation.
   (d) The length of ears of corn in various sections of the United States.
   (e) The per cent. of corn on the cob.

III. Method of Presentation—Take the pupils to the field and show them the corn when in bloom. Let the pupils observe the pollen dust. Teach them what this dust is for. Late in the fall gather some ears of corn and show the children why the corn is "mixed"; that is, you will find some kernels that will be of different color from the other kernels.

Have the pupils bring ears of corn to school, count the rows on each ear, and the number of kernels on one row; from this have them estimate the number of kernels on each ear. Many problems may be worked out by the teacher and pupils.

Lesson 12.

It is very important to know how new varieties of plants are formed. There are three distinct methods in which this is accomplished, viz: by cross fertilization, self fertilization and close fertilization. If we take corn for an example, an explanation can be made of how each fertilization is brought about. Now let us go out into a field of corn when it is silking and tasseling. All of us have noticed a yellow material that comes from corn when it is in bloom. This material falls on the silk of the corn and in turn it goes down the silk and fertilizes each grain. When the pollen of a plant enters the ovary of the

plant not related to it in any way, this is called cross fertilization. When the pollen of a plant enters the ovary of the same plant, this is known as self fertilization, and the result is almost invariably an inferior offspring. The third fertilization is where a plant fertilizes the ovules of the related plant of the same variety, this is called near or close fertilization. From these three sources named above all of the varieties are formed.

All of our public schools can have some corn grading and judging a few minutes every day, until the pupils are acquainted with the different parts of the corn. Study the plants given below briefly and see if you cannot interest your children a little each day.

1. The length of the ear of corn in the Southern section of the United States is from 9 to 10 inches, Northern and Central States have standard for lengths of corn one-half inch shorter.

2. The kernels should be uniform in size, shape and be of the same color. They must be sound and well matured, free from worm holes or insect's injuries in any way. The tip of the kernel should be well developed.

3. The rows of the knernels should be straight and continuous from the tip of the ear to the butt.

4. The cob.—White corn should have a white cob, yellow corn should have a red cob.

5. Per cent of corn to cob: Corn 85 to 87 per cent, cob from 15 to 13 per cent. Butts should be well proportioned; kernels uniform in size and well arranged in a cup shade cavity.

6. Tips should be well covered with kernels of a uniform size.

The Southern Corn Belt

From the United States Year Book we get the following data:

	Bushels
Texas	181,280,000
Mississippi	66,256,000
Georgia	65,714,000
Alabama	63,432,000
Louisiana	58,832,000
North Carolina	57,139,000
Virginia	54,621,000

South Carolina 44,733,000
Florida 8,814,000

If you search the year book you will find that the greatest yield of corn is in the Northwestern states. These states contain the best kind of soil for corn growth; that is, the alluvial or glacial soil, which is easily made friable. The Southern states can be made great corn growing states also, if the right kind of farming is carried on. The worn out soils of the South must be made fertile by green manuring, barnyard manuring, crop rotation and the right kind of tillage.

Experiment 14.

To show that the root of a plant needs air. Take several root cuttings of Wandering Jew or some similar plant that can be rooted in water. Place one or two cuttings in ordinary spring or well water that has been boiled and put a few other cuttings of the same kind of water that has not been boiled. To keep the boiled water from absorbing air, cover the top of it with oil.

To Show That the Leaves Do Not Take Moisture to Any Appreciable Extent.

Experiment 15.

Take a few leaves of some plant, let them be the same size as near as possible, place about half of the leaf under water. Let the tips be downward. Now take a second lot of leaves of the same plant and of the same size, put them in water and place the stems downward. Which set of leaves will wilt the quicker? Why is this? What lesson do you get from this experiment? Let the teacher right here draw out from the children why flowers and other green plants are put in water stems downward.

SEED TESTING

Lesson Plan 13.

I Purpose of the Lesson—To teach the pupils how to test the various kinds of seeds.

II. Analysis of the Subject Matter:

(a) The selection of seeds.

(b) Mixing and separation of various seeds.

(c) Determination of the number as well as the time required for germination of the various seeds used in the garden and field.

(d) The percentage of live seed.

III. Method of Presentation—Have the children bring to school various seeds which they plant at home. Select several kinds of the seeds brought to school, such as corn, beans, peas, watermelon, beets, tomatoes and onions, mix all these seeds together; allow the children to separate them according to the variety. When the separation has been completed, give the samples of seeds their true names. Put them in vials; label, for the purpose of future identification. Keep all the common seeds before the pupils until they are familiar with all the seeds planted in the community. When this is done, begin to compare the different seed of the same family, such as cabbage, kale and collard seed.

Lesson 13.

For most seeds six days are required for the test; for beets, cotton, cowpeas, onions, tomatoes and melons two days longer should be allowed; for spinach and salsify, ten days; for carrots, celery and tobacco fourteen days; while for blue grass and parsley, twenty-eight days.

Experiment.

Object—To show the pupils how small seeds may be tested with simple devices.

Material—Seed, water, blotting paper or canton flannel and two plates.

Procedure—Count out one hundred seed of the sort to be tested and place them between two pieces of moist blotting paper or folds of canton flannel. Put the blotting paper containing the seeds in a plate and turn another plate over it to keep in the moisture. Watch the seeds and observe the condition of

them every twenty-four hours. When the germination is complete take an account of all seeds put on the blotting paper, and determine the percentage of those that would produce healthy plants.

Experiment.

Object—To show the pupils how to test corn.

Material—Corn, testing box, sawdust and water.

Procedure—First, make a testing or germinating box. Such a box can be constructed by any one in an hour. For testing fifty ears, a box should be about three inches deep, twenty-four inches wide, and thirty inches long. The ears that are to be tested should be put on a shelf or table and all weak ones thrown out before beginning the test. Now fill the box half full of sawdust that has been soaked in warm water for an hour. Remove the excess of water from the sawdust before putting it in the box. When the sawdust has been put in the box pack it down level and firm with a brick, leaving the surface smooth and even. Above this layer of sawdust should be placed a piece of white cloth preferably sheeting, which has been ruled into oblong spaces two and half inches by four inches. A margin of two and half inches should be left along the oblong spaces. The spaces must be marked from one to fifty to correspond with the fifty ears of corn to be tested.

Remove six kernels from six different places on ear number one and place them on space number one of the germination box. In moving kernels take two from the butt on opposite side of the ear, two from middle, and two from the tip, turning the ear enough so as not to take two kernels out of the same row. Do the same thing with all the ears that are to be tested. Lay the kernels in the spaces with tips all one way, and germ side up, this is very essential. As soon as the kernels are all carefully arranged, the germination test is ready for the cover cloth. Dip the cover cloth in warm water and wring it out before using. The cover cloth should be several inches larger than the box. It is advantageous to raise the edge of the box toward which the crowns of the kernels are pointed. To do this will help materially in the test. After laying the cover

cloth on the kernels of corn, fill the box with warm wet sawdust. Pack the sawdust down on the cover cloth with a brick as was done with the first cloth. It generally takes about eight days for the corn to germinate. Place the test box in some place where the seeds will keep warm. After eight days carefully roll off the top cloth together with the top sawdust. Those kernels showing weak sprouts or none at all should be discarded. It is easy to tell which ears are good to plant and those that are unfit to use. From the poor ears tell how many missing hills would be in a field using one grain to the hill, if fifteen hundred kernels were on the ear. What per cent. of the field would have good stalks, providing the birds and worms did not injury any of them?

Lesson Plan 14.

I. Purpose of the Lesson—To teach the children how to make gardens and choose the various seeds for them.

II. Analysis of the Subject Matter:
   (a) The making of a garden.
   (b) Selection of various plants for a vegetable garden.
   (c) The time to plant various garden crops.
   (d) The manner of working the various garden crops.

III. Method of Presentation. Lee each pupil select a garden, work it up in the fall so early planting may be carried on. During the winter the pupils may be taught the name of seeds and plants, and the methods of planting and cultivating.

A Typical Garden.

Lesson 14.

There are at least three things necessary in a successful garden: namely, suitable soii, pure seed, clean cultivation. To these may be added, as equally necessary, a good supply of barnyard manure; and, when this runs short, supplementing it by an application of some good artificial fertilizer.

Fertilizer.

Experience teaches us that there are no crops that draw on

the soil more than vegetables, as we sometimes take two or more crops off of the same land in one season. It is therefore necessary that a good supply of manure must be used. The best manure to use for the garden is well rotted barnyard manure.

When stable manure is used, about 50 tons to the acre is considered the best amount. In using barnyard manure, spread it over the ground, plow it under and work it in the soil with finer tools afterwards, or better still, disc harrow the ground, spreading the manure, then plow the land.

Rotation of Crops.

Rotation in the garden crops is very essential; and in order to be successful, it must be carried out even more so than in farming. Rotation in garden is a very easy matter, but a very important one indeed. Different vegetables, like farm crops, draw different elements from the soil. It is necessary where such deep-rooted kinds as beets, turnips, carrots, parsnips have grown the previous season, that they should be followed with more shallow rooted plants, such as lettuce, onions, beans, cauliflower and cabbage.

Corn may be alternated with melons, squash, pumpkins and cucumbers. Do not plant the cabbage tribe on the same land too often.

Selection of Varieties of Plants for a Vegetable Garden.

Asparagus: Conover's Colossal, Palmetto.

Beans: (Early) Improved Valentine and Extra Early Refugee; Red Valentine, Giant Stringless Green Pod and Refugee, or 1000 to 1.

Lima Beans: (Early) Fordhook Bush Lima, Mammoth, (late) Prolific.

Beets: (Early) Eclipse and Crosby's Imp. Egyptian Beet, (late) Improved Long Red.

Cabbage: (Early) Jersey Wakefield and Charleston Wakefield, (late) All-Season, Flat Dutch and Drum Head.

Cauliflower: (Early) Snowball, (late) Large Algiers.

Carrots: (Early) Scarlet Horn, (late) Half Long Denvers.

Celery: (Early) New Rose and Golden Heart, (late) Winter Queen and Giant Pascal.

Collards: Southern Short Stem and Georgia.

Corn: (Early) Adam's Extra Early and Truckers' Early Sugar Corn, (late) Country Gentleman and Late Mammoth.

Cucumbers: Early White Spine, Early Green Prolific and Improved Long Green.

Egg-Plant: Black Beauty and New York Purple.

Kale: Norfolk and Extra Curled New American Kale.

Lettuce: Big Boston, May King and Improved Hanson.

Musk Melon or Cantaloupe: Rocky Ford, Anne Arundel and Extra Early Hackensack.

Okra: Perkin's Mammoth and Dwarf Green Prolific.

Onions: Large Red Wethersfield, Silver King and Yellow Globe Denvers.

Parsley: Moss Curled and Double Curled.

Parsnip: Hollow Crown and Guernsey.

Peas: (Early) Gradus, Nott's Excelsior and Eureka; (late) Everbearing and Improved Stratagem.

Pepper: Bull Nose, Sweet Spanish and Long Cayenne.

Potatoes: Early Ohio, Red Bliss and Irish Cobbler.

Pumpkins: King of the Mammoth and Large Cheese.

Radish: (Early) Scarlet Globe and White Box, (general) White Strasburg and Chartier.

Spinach: Bloomdale and Victoria.

Squash: (Early) Wihte Bush, Mammoth Yellow Summer Crookneck and Golden Custard; (late) Boston Marrow and Hubbard.

Sweet Potato: Nancy Hall, Jersey Sweets and N. C. Yam.

Tomatoes: (Early) Spark's Earliana, June Pink; (late) Acme, Ponderosa, Crimson Cushion and Stone.

Turnips: Purple Top Globe, Snow Ball and large White Norfolk.

Water Melons: Tom Watson, Lord Baltimore, Duke Jones, Florida Favorite and Kolb Gem.

Succession of Garden Plants.

Asparagus.—Although the sowing of seed is the most economical method of growing asparagus, it is somewhat uncer-

tain and generally requires three years to get marketable shoots. Most gardeners buy roots instead of seed. Plant as early in the spring as the ground can be worked. Have ground thoroughly enriched; plant the roots out two feet apart each and six inches deep; cover about one inch deep; then gradually work in the soil until the furrows are full or level with the surface. Such a bed may last from ten to fifteen years.

Beans.—Select light warm soil and plant when the danger of frost is past in the spring. Sow in drills two to two and one-half feet apart, dropping the beans about two inches in the row and and cover two inches deep. Plant every ten days until eight week before frost, which is about the middle of August.

Lima Beans.—Plant about the first of May in hills 12 to 15 inches apart in the row. The rows should be wide enough to use a cultivator in working them, about three feet.

Beets.—Sow one inch deep, as early as the ground can be worked, in drills four inches apart; then every three weeks until the middle of July. The long kind will take more time to mature.

Cabbage.—Plant as early as the ground can be worked. The early varieties may be planted in rows two feet apart each way. The late sorts may be planted as late as the first of August. Let them be planted about three feet apart in the row. Hoe cabbage frequently. Be sure to draw the earth up to the stalk.

Cauliflower.—Plant out early in the spring after frost, later varieties may be planted out about the middle of July. Cauliflower should be worked the same as cabbage.

Carrots.—Carrots should be sown in light fertile soil, which has been heavily manured for a previous crop, as fresh manure will encourage side roots and irregularity of shape. Sow drills one inch deep and two feet apart, leaving about three inches between the plants. The short varieties may be sown as early as the ground can be worked in the spring. For late crop sow in July and August.

Celery.—Plant seed in hotbed or very early in the spring in the open ground. Transplant four inches apart when three inches high in fertile soil, finely pulverized; water and protect until well rooted. In June or July transplant into permanent

rows three feet apart, either on the surface or well-manured trenches a foot in depth. Half fill the trenches with well-rotted manure. Set the plants from six to eight inches apart in the row. When the plants are well set and making rapid growth, gradually draw the soil around them as they grow. In October and November they can have their final banking. This should make the desired blanching.

Collards.—Collards belong to the cabbage family, very closely related and for this reason they must be treated about the same way as cabbage. Sow the seed in beds from March until July, to be transplanted in the garden when large enough. The soil for collards should be fertile as they are gross feeders. Three feet each must be given the plants, as they foliage is very abundant.

Corn.—Early corn may be planted in rows three feet apart, and the seed placed about eight inches apart in the rows, or planted in hills three feet apart each way. Do not let more than three plants remain in each hill. Corn can be planted from April until the last of July for succession of crop. By planting every two weeks a family may have good corn throughout the season.

Cucumbers.—For very early cucumbers sow the first of April in a hotbed upon pieces of sod (grass side down), so that they can be readily transplanted to the open ground in rich soil when danger of frost is over. Plant after the ground has beocme warm in hills four feet apart for the smaller varieties and five feet for the larger sorts. For pickling, sow from the middle of June to last of July. Plant six seeds to the hill, one inch deep. Thin out to three or four plants to the hill when the third leaves come on the plants well.

Egg-plant.—To have early egg-plants sow in hot bed the first of March. When three inches high, pot the plants and place them in the same bed so that they will become stocky. Transplant them from the pots to the field when the ground is thoroughly warm. Let the plants stand in hills two and half feet each way. Keep the soil loose and clean about the plants; gradually draw the soil up to the stems.

Kale.—Plain kale may be sown nearly the year round, either

in drills or broadcast. Sow half an inch deep in rows two and a half feet apart, allowing about six inches between the plants. Cultivate the same as cabbage. Kale is a strong feeder, therefore it needs a fertile soil to thrive well.

Lettuce.—Sow seed as early as the ground is ready, and a little more every fifteen days until June 15th. Transplant in drills, or between other crops, eight inches apart, six inches in the row. Keep the soil clean and loose about the plants.

Musk Melons, or Cantaloupe.—Plant in hills in April, four feet apart each way. Make the hills fertile with well rotted manure. Sow about ten seeds to the hill, one inch deep. When they are three leaves high, thin out to three plants. The vines may be pinched off when about a foot long to make them branch, and ripen the fruit earlier.

Okra.—Sow early in May. Sow in drills two feet apart for the low varieties and four feet for the tall varieties. Sow from May until July, thinning the tall sort one plant for every three feet, and one plant every two and half feet for the short varieties.

Onions.—Plant out the sets early in the spring in rows three feet apart and then place in the soil two inches deep. Plant the sets four inches apart in the row. Make the soil rich if a good crop is desired.

Parsley.—Select rich soil; sow the seed in drills one foot apart, covering half an inch deep. It will be well to make the soil firm with the foot after sowing the seed. It takes the plants about three weeks to germinate, therefore sowing should be done early. Thin plants to four inches in the row.

Parsnips.—Sow in drills early i nthe spring one foot apart and half-inch deep; thin in the row to four inches. Parsnips will be nourished best and give the longest roots in deep rich soil.

Peas.—Sow as early as the ground can be worked. The dwarf should be manured well, but the tall varieties will go to vines if fertilized too heavily. Fall varieties of peas may be sown about the latter part of August in fertile soil.

Peppers.—Sow in drills as soon as the ground is warm, about the first of May. Let the rows be two feet apart and set

the plants eighteen inches in the row. A fertile soil is essential.

Potatoes.—Plant the cut pieces of potatoes in furrows early as the soil can be worked. Let the furrows be six inches deep and drop the pieces a foot apart in the row. Use good pieces with at least two eyes. A sandy loam soil is the best potato land.

Pumpkins.—Plant in drill eight feet apart each way. Manure the hills with some well rotted manure. Plant six seed to the hill. When plants get four leaves, thin to two in a hill. Never plant pumpkin seed until the soil gets warm.

Radish.—For an early supply sow in hotbed in February. For a successive supply sow from the middle of March to September. You can sow between crops in drills nine or ten inches apart. Thin out to two inches in the row. Radishes thrive best in light, rich, sandy loam. Radishes must make a rapid growth to be fit for use; they will be crisp and tender and of a mild flavor if forced.

Spinach.—Sow in April, in drills one foot apart and one inch deep. Sow every fifteen days until the middle of July. Sow in September for fall and winter use. For spinach to stand the winter cover with a thin layer of straw. This crop must also have a fertile soil to do well.

Tomatoes.—For early fruit sow the seed in February and March, in hotbed. When the plants are about four inches high they should be set out four or five inches apart in cold frames, and exposed to air as much as possible to harden them off. When the soil is thoroughly warm, transplant to the garden. For late varieties sow in beds when the soil gets warm and plant in the garden in May and June.

Sweet Potatoes.—Bed the potatoes in specially prepared beds about the middle of March. When the "slips" are about four inches high they are ready to be set out into the garden. Do not set them until after the danger of frost. Set on beds made by throwing two furrows together with a turning plow. Set the plants about fifteen inches apart on the bed.

Squash.—Squashes are all quite tender, and therefore no progress can be made in starting them until the weather gets warm. Plant in hills four feet apart each way for the bush

varieties. For the running varieties, plant about six feet apart in hills. Allow three plants to remain in each hill.

Turnips.—For early varieties sow about the last of February in drills two feet apart, and thin the plants to four inches in the rows. For fall and winter use sow from the middle of June until the first of September. Turnips may be sown in drill or broadcast. The soil must be manured well to get large turnips.

Water Melons.—A rich, but light soil is best suited for water melons to get the desired result. Plant the seed half an inch deep in hills from six to eight feet apart each way. Never plant until the ground is thoroughly warm. After the first cultivation, all other work must be shallow and the crop "laid by" as soon as the ground is well covered.

FIELD AND GARDEN CROPS: THEIR CULTURE

Lesson Plan 15.

I. Purpose of the Lesson: To teach the pupils how to grow certain crops.

II. Analysis of the Subject Matter:
   (a) Field crops.
   (b) Corn; its culture.
   (c) Wheat; its culture.
   (d) Garden crops.
   (e) Beans; their culture.
   (f) Potato; its culture.

III. Method of Presentation. When each of the above crops is studied, call attention to the crop as it is grown in the neighborhood. Is the crop in question a success or a failure? After the methods of several farmers have been studied, select the one pursued by the most progressive farmers in growing each of these crops. The teacher should study books and bulletins upon field and garden crops.

Lesson 15.

Field Crop—Corn Culture.

Corn likes a rich soil. It likes a soil that stays moist, but it

does not like one that is watery very long after a rain. Sandy loam soil seems to be the best one for corn, especially where it has been enriched with barnyard manure or commercial fertilizers of the right sort.

The land should be broken or plowed at least eight inches deep, and then, it should be harrowed, rolled, until all clods are thoroughly pulverized. It is now ready for planting.

Fertilizing.

Where stable manure can be had, nothing can beat it. It should be spread broadcast before plowing, or breaking the land. In the case of commercial fertilizer, half of it may be put in the furrow made by the corn planter and the other half spread on the land after the corn is about eight or ten inches high. When clover and rye are used as a manure these should be turned under when in bloom.

Planting

The grains of corn may be planted in two ways, viz., drilling and hilling. Both these ways have their advantages and disadvantages. Where one drills his corn, one grain is put every eight or ten inches apart in a row. Advantage of planting corn this way is that one can reap more fodder to the acre and sometimes more corn. Disadvantage, it will take more to keep such a crop clear of weeds and grass. Where four or five grains are put in hills three or four feet apart in the row this is called hilling. Hilling is generally done on the check row system. Advantage is, that the corn can be cultivated both ways and save so much hoe work; disadvantage, less corn and fodder to the acre can be harvested. The grains of corn should be covered with fine soil from one to two inches deep. The dirt or soil should be pressed firmly with the hoe, or in the case where a corn planter is used, the wheel will pack it sufficiently.

Cultivating Corn.

Corn likes a clean, mellow soil, as well as a fertile one. It is a good plan to harrow corn land just before the plants come up. The first harrowing should be very light for fear of digging up the plants. The fine surface helps to keep the soil moist below the fine layer, and in the meantime tends to keep down many of the weeds.

After the corn is large enough to work, it is a good plan to cultivate at least once in every eight days during the growing period. In hill corn two to three stalks are enough to remain in a hill. Of course this will depend upon the fertility of the soil whether more or less should be left to stand.

Harvesting Corn.

The corn is ready to cut and shock when the husk or shuck on the ear is dead, and dry, and the grains are hard and shiny. This will occur while most of the stalks and leaves are still green. Put from fifty to one hundred hills in a shock. Tie the shocks firmly and leave standing in the field for about five weeks. Of course this will depend upon the weather.

Gathering Seed Corn.

The best place to select the seed corn is in the field. The selection in the field should begin during the growth of the crop. Let the farmer pass through the fields when the ears are well formed on stalks, and when he finds a large well-formed ear on a sturdy, well-developed stalk mark it by tying a piece of cloth around the stalk. At husking time the ears from the marked stalk must be kept separate from the others, and from these should be selected for the next year the ears that nearest approach the ideal.

Wheat Culture.

It has been found by experience that early plowing for wheat is better than late. The wheat crop seems to need a settled, plowed field, and this condition is secured by plowing the soil early. Soon after the ground has been plowed for wheat, it should be harowed to make the seed bed firm.

Fertilizer for Wheat.

Wheat, like the other cereals, requires much plant food, and for this reason it is necessary to apply fertilizer of some kind. Stable manure seems to be the best, but this should be applied to some other crop just preceding the wheat crop, in a rotation. Too large a quantity of manure is likely to supply too much fertility so that the wheat stalks may grow so fast that they will fall over or lodge as it is sometimes called.

Commercial fertilizer is sometimes used for a wheat crop, especially when the land has been farmed for a long time. A

fertilizer containing four per cent. of nitrogen, twelve per cent. of phosphoric acid and four per cent. of potash, seems to be the best for wheat. Sow from 250 to 400 pounds per acre.

The Time of Planting Wheat.

The time for planting wheat will vary with the season; for North Carolina from the first of October to Thanksgiving day would be a good time to sow wheat.

Depth of Planting.

The depth of planting wheat will greatly depend upon the soil. Where the soil is well prepared and not very dry, two inches dep is about the right depth. The quantity of seed to plant per acre will vary from one and a half to two bushels. Early planting will require less seed than late planting.

Care of Wheat During Growth.

Caring for the wheat crop after seeding is an important thing. In case a heavy rain occurs soon after the wheat is planted, it is likely to flatten the little ridges between the drill rows. This will cause the silt to be deposited in the little depressions between the rows in which the seed have been planted. Of course this is where a grain drill has been used. The sunshine that follows a rain will cause the silt to bake, and a crust will be formed over the seed, thus preventing the seed from coming above the ground. Sometimes it will be necessary for the farmer to reseed his land, or, if it is too late, another crop may be planted.

Time of Harvest.

No set time can be given to harvest wheat; it should be cut when ripe. In North Carolina almost all of the wheat is cut in the month of June, just when the straw is turning yellow. The conditions for cutting wheat is favorable. At this period the grains are soft enough to be indented with the finger nail and hard enough not to be crushed by pressing them between the fingers.

Machines for Harvesting Wheat.

The old fashioned cradle is used in many districts where small crops of wheat are grown. The self binding harvester is the most economical machine used for cutting wheat and other grain crops. This machine cuts the grain and binds it in bun-

dles, and deposits them in piles of five or six bundles. After the grain is cut the bundles should be put in shocks, containing ten to twelve of them.

Threshing Wheat.

About a week after wheat is cut, it will be ready for threshing. In North Carolina the threshing machines are operated either by horses or by steam or gasoline engines.

DIRECTIONS FOR THE RAISING OF BEANS

Kind of Soil.

Several kinds of soil can be put into condition so they will produce a good bean crop, viz: sandy loam, gravelly loam and clay loam, if well drained. Beans will not do well on a soil that stays wet and heavy. Beans need a rich soil to yield well. Barnyard manure well mixed with the surface is a good fertilizer, and it helps hold the moisture near the surface. Other fertilizers should contain potash and phosphoric acid principally.

Preparing the Soil.

The ground should be well plowed to the depth of eight or ten inches. The surface should be made very fine with a harrow or a garden rake. This will allow the soil to pack well around the bean when planted.

Planting.

Make little furrows about three inches deep. Place the beans in a furrow from three to four inches apart. Make the rows a foot and a half apart. Cover the beans two and a half inches deep wtih very fine soil. Pack the soil somewhat, for this gets the fine soil close around the seed, and also helps to keep the moisture where the dry bean can get started to grow.

Cultivating.

Begin to use the garden rake to keep the ground fine, as soon as the little beanlets come up. The soil must be worked very shallow to prevent injury to the plants. Keep the ground in cultivation between the rows until the green snaps are about ready to pick. Then draw some fine soil around the stems. Do

not work beans when they are wet as any bruises will allow diseases to start.

Fertilizing.

Barnyard manure is the best to use when put on in the fall, then harrow well before planting. If commercial fertilizer is used, it should contain about 1.3 per cent. of nitrogen, 8.7 per cent. phosphoric acid and 12.5 per cent. potash.

Beans are, as a rule, free from disease, therefore I shall not discuss it. Sometimes it will be necessary to treat the vines with dry ashes to keep the little green bug away while the plants are young.

POTATO CULTURE

Preparation of Seed Bed.

First of all select a deep mellow and free working soil, one that is not stocky, which does not cling to your shovel or hoe. Prepare the soil as early in the spring as possible, by plowing it to a depth of eight or more inches. Sub-soiling in many cases will prove beneficial. Potato roots like the soil loosened very deep.

After plowing, make the surface soil as fine as possible by harrowing and raking. Work the ground over until there are no lumps or clods left in it. Harrow the ground immediately after plowing or not later than a day after.

On the day of planting make furrows the length of the potato plot 3.5 feet apart and about six inches deep, and as straight as they can be made.

Application of Manure and Fertilizers.

If manure is used, let it be broadcast over the land. Well rotted manure is better than fresh from the stable, but both kinds are liable to increase the disease called "scab." This makes the tubers rough, warty and undesirable, and unsalable. Sometimes it is better to depend upon commercial fertilizer for this crop. Spread one-half of the fertilizer in the open furrows thinly and evenly, and mix with soil as other manures are used. Spread the other half when the plants are about four or five inches high.

Preparation of the Seed for Planting.

The tubers that are to be used should be cut several days before planting time; due care must be taken to keep from heating before planting; and it is well to dust a little land plaster over the tubers to prevent the excessive wilting.

In cutting seed potatoes it is well to cut two eyes to the piece as this will insure a good stand. The cutting may be done with a pocket knife.

Treating Potatoes for the Scab.

Treat scabby potatoes by soaking them in a mixture made of formalin and water. Use one ounce of forty per cent. formalin in two gallons of water. Let the potatoes soak in it about two hours. Take them out and spread them out to dry. This same mixture may be used several times. The formalin may be bought at the drug store for about five cents an ounce. Handle formalin carefully because it is a poison.

Planting.

We now have the soil prepared, the manure spread, the furrows opened, and the seed treated for scab, and potatoes cut for planting. Drop the pieces in the furrows six inches deep, fifteen inches apart in the furrows, cover the seed three inches at first and gradually work the soil to the vines as they come up.

Cultivating.

After the crop is started keep the surface fine by frequent stirring. Watch the crop carefully and cultivate often to keep down the weeds. At each cultivation a little earth will be pushed down into the partly filled trench. By the time the vines are four inches high this trench will be filled. When the vines are five inches high, the remainder of the fertilizer should be applied on both sides of the row. Do not let the fertilizer touch the plants. Stir the soil immediately after the application of the manure.

Potato Bugs.

If the bugs get troublesome, pick them off by hand or poison them with Paris green. If you use Paris green in the dry form, mix one pound of it with fifty pounds of flour. Sprinkle on leaves. Where water is used take fifty gallons of water to one

pound of Paris green. Paris green is deadly poison and should be put out of the way of children.

Harvesting Time.

The harvesting time is when the vines are dead and cease to show green on the stalks. Do not break the skins of the tubers, as this injuries their market value. Allow the tubers to dry in the field, but as son as dry remove at once to a dry place for sorting. Sometimes the sorting is done in the field.

The Delaware and Maine way of preparing potatoes for the market seems to be a good way. Sort the potatoes into three grades: No. 1, large, regular and smooth, having no tubers smaller than a hen's egg; No. 2, those about the size of a hen's egg; No. 3, pig potatoes, which include all the small and badly scabbed potatoes and those injured in digging. This kind of grading will pay.

Lesson Plan 16.

I. Purpose of the Lesson: To teach the pupils how to treat diseased garden plants. Secondly to give some idea of how solutions may be made in order to destroy insect pests.

II. Analysis of the Subject Matter:
   (a) The time to spray.
   (b) What to spray with and what for.
   (c) Making fungicides.
   (d) The making of insecticides.

III. Method of Presentation: Have the pupils in the class to study the kinds of insects they find on their garden crops. Let them determine what remedy is needed in order to kill the particular insect. Have each pupil become familiar with the different poisons for insects. Also let it be known that insect poisons will injure the human body if allowed to enter the mouth. The teacher can be of great service to the community if he will teach the older people how to make the several solutions and the application of the same.

GENERAL TREATMENT FOR DISEASED GARDEN PLANTS

Lesson 16.

Time to Spray for Potato Bugs.—Begin to spray when the bugs first appear on the vines and continue to spray every ten days until the growth stops. Spray more frequently in hot damp weather and less often when it is dry.

What to Spray With and Why.—Bordeaux mixture for early blight and rot, combined with lead arsenate, three pounds to fifty gallons, for flea beetles, blister beetles, and Colorado potato bugs. Apply the Bordeaux mixture strong, using at least one pound of copper sulphate to make eight gallons of the mixture. Any book on plant diseases will give directions how to make this mixture. The several mixtures may be bought out of seed stores.

To Prevent Potato Scab.—Use commercial formalin (40 per cent. solution) 1 pint to 30 gallons of water. This is enough for twenty bushels of seed. The mixture may be used several times. Soak uncut potatoes two hours, but no longer.

General Treatment for Cucumbers, Squashes and Melons.—When young plants come through the ground, sprinkle tobacco dust for striped beetle. Repeat it frequently. Use Bordeaux mixture for blight, flea beetles and striped beetle.

When lice or aphis first appear, nicotine sulphate may be used wtih good results, if sprayed carefully under the side of the leaves.

General Treatment for Cabbage, Collards and Cauliflower.—When worms first appear, begin to use Paris green or other arsenical poison in dust. Do not apply poison after the plant begins to head. For lice, use kerosene emulsion. Terrapin bugs must be picked off by hand.

General Treatment for All Kinds of Plants.—For all leaf-eating insects, such as slugs, caterpillars and beetles, use Paris green when insects first appear. Repeat the spray when necessary.

FUNGICIDES

Bordeaux Mixture or Fungicides.

Copper sulphate (blue vitriol) .....4 pounds
Quicklime (not air slaked) .....4 pounds
Water to make 50 gallons.

Dissolve the copper sulphate in about two gallons of hot water, contained in a wooden vessel, by stirring. Pour the sulphate solution into the barrel or tank used for spraying, and fill to one-half full of water. Slake the lime by adding a small quantity of water, and when slaked cover freely with water and stir. Pour the milk of lime thus made into the copper sulphate, straining it through a brass wire strainer with very fine mesh. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but hard lumps are used up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough mixing the material is ready for use. To spray very tender plants use two pounds of each copper sulphate and quicklime instead of four pounds. In order to kill flea beetles, and potato bugs add three pounds of arsenate of lead in 50 gallons of the spray.

Commercial Formalin (40 per cent solution).

Use one pint of formalin to thirty gallons of water. Stir well before using. Spray potatoes for the scab. Soak uncut potatoes for two hours, but no longer.

INSECTICIDES

Paris Green.

Paris Green 1pound
Lime ..... 3 pounds
Water ..... 100 to 200 gallons

Upon most plants Paris green without the lime may be used up to about the first of July. Later than this, lime should always be added to neutralize the free acid. Make a fine spray on the foliage.

Paris green may be applied in a powder form, combined with land plaster, at the rate of one pound to one hundred pounds

of plaster. Paris green is used to destroy insects that bite and chew the foliage of plants, like potato bugs, cabbage and collard worms.

Kerosene Emulsion.

Soft Soap (or sour milk) ..... one quart
Kerosene ..... one pint
Water ..... six to ten quarts

Warm the soap until it becomes liquified, remove from the fire, add the kerosene and agitate rapidly, until it becomes a creamy mass, from which the kerosene will not separate on standing. Dilute with water so that the kerosene will be one-fifteenth to one-twenty-fifth of the entire mixture. If properly prepared, it can be used with safety upon naerly all plants, except squashes, melons, cucumbers and others of the squash family. This is a remedy for all sucking insects, and for others having soft bodies, with which it can come in contact. In spraying with kerosene emulsion the solution must actually touch the insect which you are trying to kill.

Sucking insects, such as plant lice and true bugs.—Tobacco dust or nicotine sulphate, soap suds or kerosene emulsion will prove beneficial. Small plants or ends of twigs are best treated by dipping.

Any one may get more literature on how to make up the several solutions by writing to any of the Experiment Stations or to the Agricultural and Technical College, Greensboro, N. C.

ADDITIONAL EXPERIMENTS.

Experiment 1.

The capacity of soils to take in rainfall. Materials needed for the experiment: Five soils, namely, sandy loam, sandy, clay, clay loam and leaf mold, or you may use the common mixture of soils in your locality. You may use the same lamp chimneys as in the experiment above. Use a small box with holes bored through the bottom for the chimneys to run through. The box is to be used as a rack. Now put the chimneys in the rack that you have made and let a thin piece of

cloth be over the small end of each chimney. Fill each one up to one inch of the top with different kinds of soil. Put a glass under the lower end of each chimney. Now take a glass of water and pour it over the soil in the first chimney. Note the time and record it. How long before water begins to drop out into the empty glass? Do likewise with each of the other chimneys containing the several soils. Which takes water most rapidly? Notice which soils drop the longest. Which would lose water more easily? Which held the most water? What do you learn from this experiment? Use a watch to keep the time in this experiment.

Experiment 2.

Plant melons, squash and cucumber seeds in small boxes in school room windows, or better still, have a window box made. In this, plant seeds one-half inch, one inch, two inches and four inches deep. By their rapidity of growing and strength determine the best depth to plant each of these seeds. Also plant a few grains of corn, beans, peas and wheat. Observe their method of coming up. Which bring out the hulls? The first leave or cotyledons, as they are called? Which come up in a loop?

Experiment 3.

Plant three hills of potatoes as follows: One hill containing a seed piece with one eye, one with two eyes and one with a whole potato. Determine from the product of these hills the number of eyes to plant. Keep notes on all work done. Treat each hill alike.

Experiment 4.

Plant six hills of small potatoes and plant six hills of large potatoes. Work both plots in the same manner, and determine which size potatoes are best to plant.

Experiment 5.

Plant six hills of potatoes to the plot. Plant one plot of potatoes two inches deep. Plant second plot four inches deep, plant the third plot six inches deep, plant the fourth plot eighteen inches deep. Cultivate all the plots in the same manner. Keep a record and determine the best depth to plant potatoes.

Experiment 6.

To show the best depth to plant corn, beans or any other seed, take a small pickle bottle, fill with good garden soil. While putting in the soil insert a grain or corn at each inch of depth. Let seed be against the inside of the vessel so they may be observed. Be sure to notice how soon they come up; see whether the plants take the seed with them or leave it behind. Determine whether the plants or roots are formed first.

Experiment 7.

Take two lamp chimneys. Tie a thin piece of cloth over one end so that they can be filled; now fill one chimney with fine soil and the other with a very coarse soil. Set them in a pan of water with the closed end down. Let one side be slightly raised so the water can get in freely. Watch the water rise through the two types of soil. Does it rise with equal rapidity? Repeat the experiment by filling the one chimney half full of fine soil and the other half with coarse soil. Put in water as before and notice what happens when water passes through the fine soil. This experiment explains the reason why the soil should be constantly stirred and kept fine.

Indoor Experiments.

Experiment 8.

Put some radish, oats or other small seeds between two pieces of moist blotting paper or cloth. Put these between two plates to keep wet. Keep these papers moist. At the same time plant a few seed in soil either out of doors or in a can indoors. After a few days the plants should be examined. Note that there are small thread-like hairs on the tips of the roots. Do you see any hairs on the tips of the roots? If so, why? Would these tiny rootlets be broken off pushing through the soil if they were on the ends of the larger roots? The use of these root hairs is to penetrate the soil or spaces between particles. Now pull up one of the plants growing in the soil. Notice particles of dirt clinging to the root hairs. Many of the hairs will be pulled off in taking up the plant. These little tiny roots absorb the soil elements needed by the plants to make the different parts.

Experiment 9.

Roots require a great deal of moisture and they grow in the direction of the moisture. Plant a few seeds in the end of a chalk box. Keep the soil in the opposite end wet. The roots will grow toward the wet end, showing that roots seek moisture.

Experiment 10.

It is easily proved that plants will not send their roots deep into the soil if the ground is not well drained. Get two tomato cans and fill them with soil. Have several holes put in the bottom of each can, so the soil may drain off the water. Let the other one be tight, to hold the water. Plant corn or beans in both of the cans and water both well. After a few days pull up the plants, compare the root growth. What advantage is it to the farmer?

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